

Supporting information

Compact, Smooth FA_{0.1}MA_{0.9}PbI₃ perovskite film with improved crystallinity for perovskite solar cells with efficiency exceeding 22%

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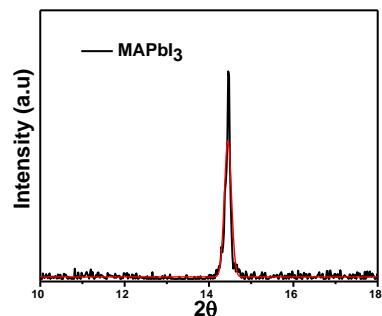


Fig S1(a): The full width and half maximum (FWHM) of MAPbI₃ based perovskite solar cell

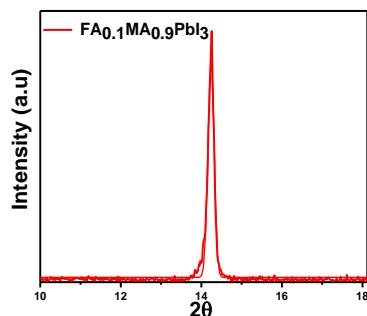


Fig S1(b): The full width and half maximum (FWHM) of FA_{0.1}MA_{0.9}PbI₃ based perovskite solar cell

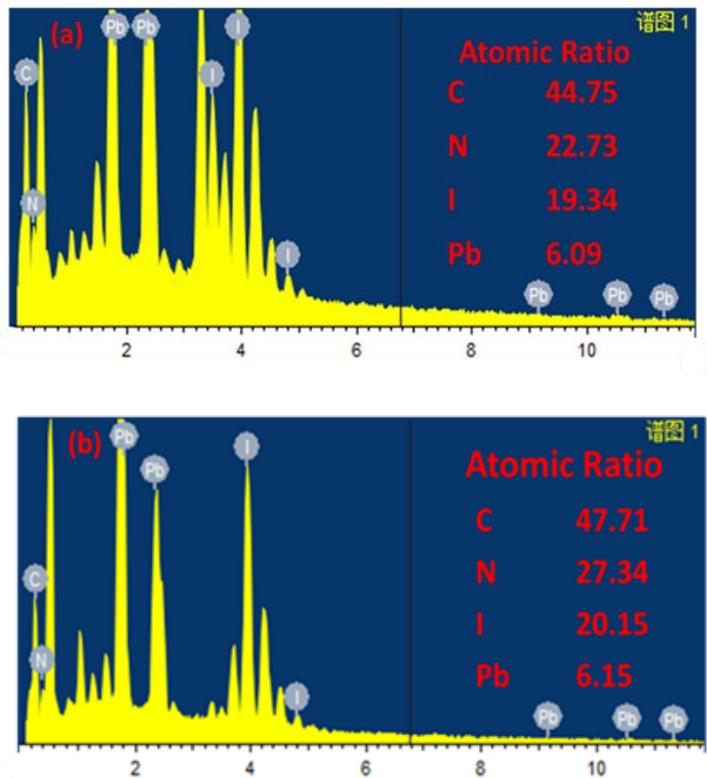


Fig S2: EDX measurement MAPbI₃(a) FAMAPbI₃ (b)

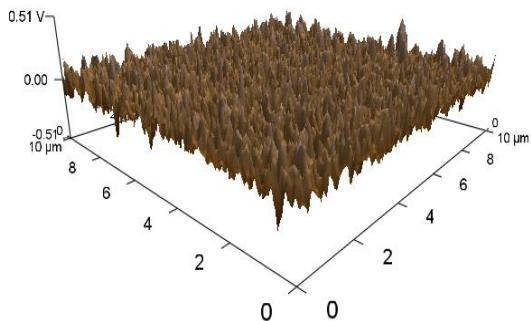


Fig S3 (a): Kelvin probe force microscopy (KPFM) images: 3D view of surface potential of MAPbI₃ based perovskite layer

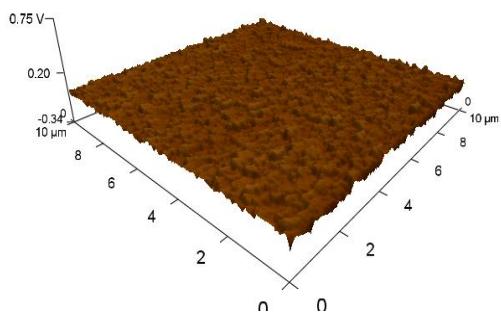


Fig S3 (b): Kelvin probe force microscopy (KPFM) images: 3D view of surface potential of FA_{0.1}MA_{0.9}PbI₃ based perovskite layer

Table S1. Parameters of the TRPL spectroscopy of standard film and modified (10%) film on the glass substrate.

The average lifetime (τ_{ave}) is calculated using:

$$\tau_{ave} = (A_1 \tau_1^2 + A_2 \tau_2^2) / (A_1 \tau_1 + A_2 \tau_2)$$

samples	τ_1 (ns)	A_1	τ_2 (ns)	A_2
Standard film	10.76	1104.48	34.06	511.93
modified (10%)	29.39	1164.96	58.32	1433.82

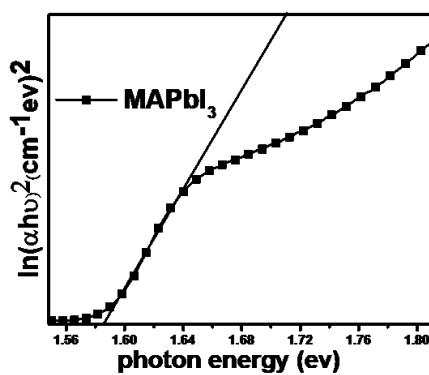


Fig S4 (a): The Tauc plot to estimated band gap value for MAPbI₃

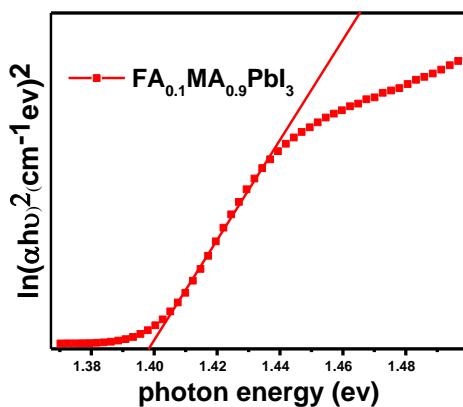


Fig S4 (b): The Tauc plot to estimated band gap value for FA_{0.1}MA_{0.9}PbI₃

Table S2: Photovoltaic characteristics with different concentration of FAI into standard MAPbI_3 PSCs.

Perovskite layer	VOC [V]	J_{SC} [mA cm^{-2}]	FF	PCE %
$\text{FA}_{0.5}\text{MA}_{0.95}\text{PbI}_3$	1.08	23.47	0.72	18.22
$\text{FA}_{0.15}\text{MA}_{0.85}\text{PbI}_3$	1.08	25.38	0.73	19.97
$\text{FA}_{0.2}\text{MA}_{0.80}\text{PbI}_3$	1.07	24.77	0.71	18.66

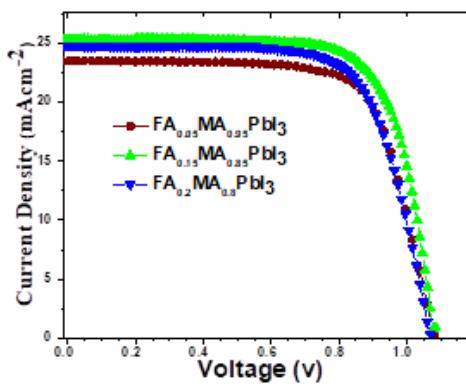


Fig S5: J-V with different concentration of FAI into standard MAPbI_3 PSCs.

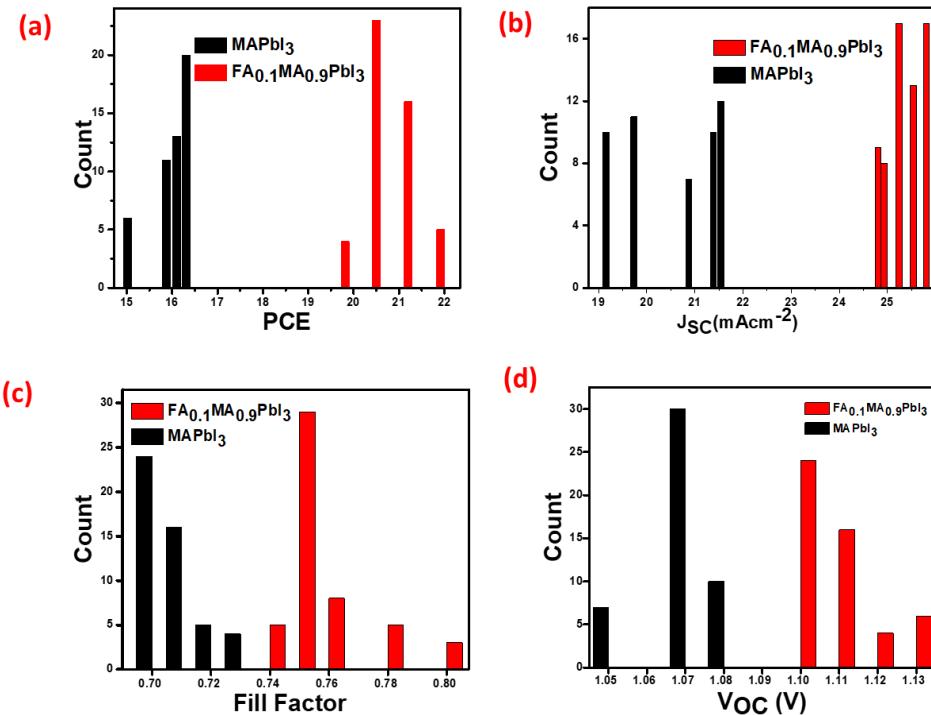


Fig S6: histogram of performance over 40 devices of PCE, J_{sc} , FF and V_{oc} of standard and modified PSC.